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THE MECHANICAL AND MORPHOLOGICAL ANALYSIS OF CARBON FIBER MATERIALS

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ABSTRACT

The natural fibre composite has used in a many more automobile and structural application in industry. In the way we are used in a hybrid composite used for those applications. The natural and synthesis fibre are high strength and low weight ratio. It is also used for alternate material in Engineering Industry. In this work the hybrid composite Neem and twiste carbon are used. The carbon fibre more strength next to aramid fiber. And the mechanical properties are studied like tensile, flexural and impact testing corresponding fracture surface also studied. Finally, in this work concluded for engineering application.

KEYWORDS: Aramid Fiber, Tensile & Flexural

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Original Article

INTRODUCTION

In this work they have studied in a kenaf fiber in a composite application. Finally they have studied the mechanical properties and morphological studies. [1]In this work they have studied hybrid composite has glass and carbon fibere. They have studied photocathlatic effect for fiber. Finally they have carried out bonding strength of the laminates. [2]They have studied only carbon fibre is used that carbon laminated studies in a mechanical propeties. [3]The work are used in a micro fibre. The micro fibre are high strength compare to normal fibre finally they have studied mechanical properties of the fibres.[4]In this study three different wovens are taken 2D (Plain woven), 3D (orthogonal), 3D(angle interlock). Finally they have used in a ballistic application for this project[5]. They have used in a chemical treatment of kenaf fiber and studied the mechanical and corrosion properties[6]in this work the kenaf fibre are used in a construction work. Finally they have proved the 40% improvement compare to the normal material.[7]in the work the composite are used in a nano rods. The nano rods are improved in the impact and tensile strenght[8]in this work calcium carbonate are used in a nano material. The nano material are improved in mechanical propeties[9]in this work the synthis fibrexial one are used. In the fibre are improved in a mechanical properties and high impact energy are observed.[10]

MATERIALS USED

Carbon Fiber

In a carbon fiber are high strength next to aramid fiber. The carbon fiber reinforcement generally the have high UTS. And impact strength. The carbon fiber and natural fiber hybrid composite gives high strength. Compare to other fiber.

RESULTS OF MECHANICAL TESTS

Tensile Test

Table 1: Experimental Results of Tensile Test

Sl. No	Sample No	Serial No	Max Load (Kn)	Displacement (Mm)	Elongation	Ultimate Tensile Strength (Mpa)	Tensile Modulus (Mpa)
1	C1	S1	4.4	14	0.75	26.84	33.8
		S2	4.2	12.7	0.76	27.52	34.71
		S3	4.6	13.3	0.76	28.11	35.54

For determining the tensile strength of the hybrid composite, universal testing machine is used. The table shows that the tensile properties of the hybrid composite sample. The graphs have been plotted between the stress and the strain and also comparison between categories with respect to each property has been shown in the Figure 1. Though the tensile properties of individual fibers are high, hence when combined it gives more significant and superior mechanical properties. The increase of fiber content in the composite laminate increases the tensile properties. The ultimate tensile strength has been recorded as 28.84in of samples with the maximum displacement of 13.5mm which is very less in the other two categories. The breaking load of 4.3kN has the highest value which is predominant whereas it reaches only 3.2kN of category 2 and 4.2kN. The percentage of elongation is 76% in category 1 when compared to other categories which are less with 75% of category 2 and 74% of category 3. The tensile modulus is relatively high in category 1 which has recorded as 741.38MPa.

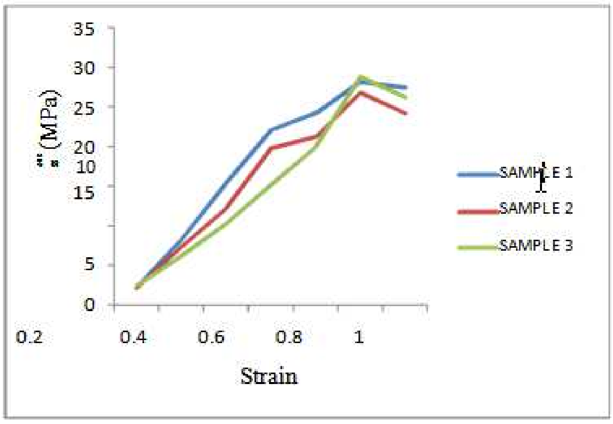

Figure 1: Tensile Test Result

Flexural Test

Flexural test can be determined by three point bending test. This furnishes the experimental results of various parameters and also comparison has been done among the properties. The graphs plotted as shown in Figure 2 for all the categories are summarized. It is clearly understood that category C3 of sample S2 shows higher flexural strength with maximum load of 1.65kN. The bending due to flexural test has been restricted to minimum level due to the presence of twisted fibers which resist bending during loading conditions. Flexural modulus of 403.95MPa is recorded high when compared to category C1. It can also be noted that the break load is high when compared to other two categories. Flexural strength mainly depends on the arrangement and orientation of fibers. Hence it is obvious that the twisting effect and parallel orientation shows better results.

Table 2: Experimental Results of Flexural Tests

Sl. No	Serial	Serial no	Break Load (kN)	Elasticity Displacement (mm)	Flexural Valve (MPa)	Flexural Load (Mpa)
1	C1	S1	1.5	3.2	36.97	422.83
		S2	1.56	3.1	37.38	415.92
		S3	1.51	3.2	40.59	408.38

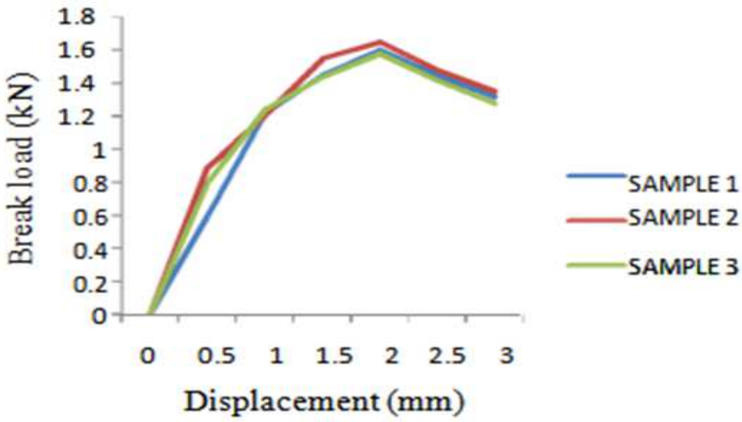

Figure 2: Flexural Test Results

Double Shear Test

The experimental results obtained are tabulated below. Graphs between the load and the displacement are shown in the Figure 3. The comparisons of various properties are also shown in the Figure. It is clearly found that category I shows superior property which has the break load of 4.04kN with maximum displacement of 34mm due to the presence of Carbon and kenaf exist in the composite laminate which shows considerably good shear properties. Both the Carbon and kenaf fibers have the tendency to improve the shear property proportionate with the matrix medium. The fiber orientation with horizontal and vertical direction influences the shear property which is very vital in the composite laminate. In all the three categories, category I has high shear property than the other two categories. In category III, sample 1 got better shear property which is followed by sample 2 of 3.89kN and sample 3 of 3.74kN with the maximum displacement of 33.89mm and 33.75mm respectively.

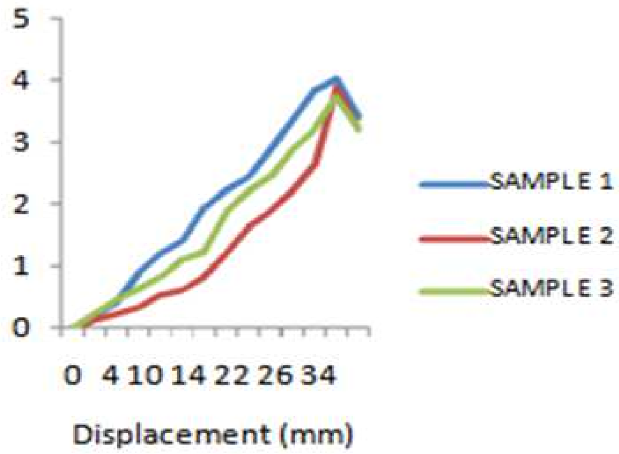

Figure 3: Double Shear Test Result

Table 3: Experimental Results of Double Shear Tests

Sl. No	Serial	Serial no	Ultimate Load (kN)	Yield Valve	Elanogation
1	C1	A1	4.00	4.00	33.91
		B1	3.82	3.83	33.86
		C1	3.71	3.83	33.72

Impact Strength

The impact strength can be determined for hybrid composite using charpy testing machine. The maximum energy absorbed during the impact is determined in joules as shown in the following table 4. The energy absorption due to sudden heavy loads is observed in three samples under three categories. The main parameter for input is the stacking sequence of fiber one over the other which forms the layer which determines the impact toughness.

Table 4: Results of Impact Test

Sl. No	Category	Sample	Energy absorbed (J)
1	C1	S1	9
		S2	7.2
		S3	7.1

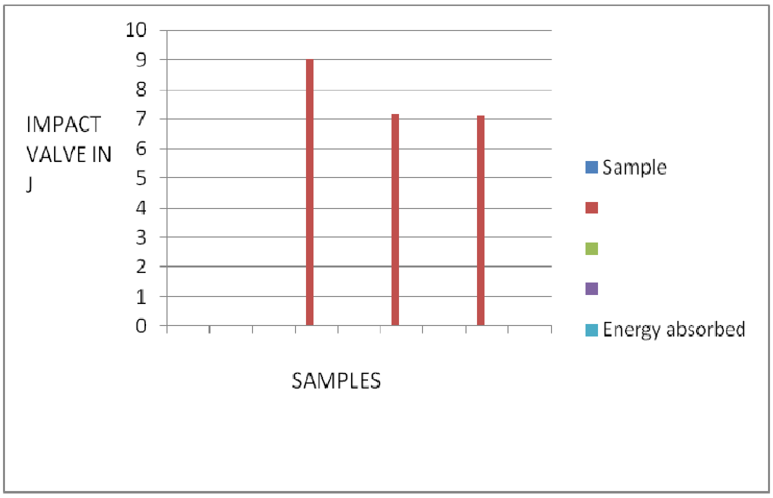

Figure 4: Impact Valves Chart Results

Morphological Analysis

Morphological analysis has been done on the tested specimens using scanning electron microscope with varying magnification factors for better visibility of the fibers in the composite laminate. The samples has been dried completely and then gold coating is done on the sample with appropriate device. Then the ultraviolet rays has been passed through the laminate and were inspected and observed by scanning electron microscope. The twisted fibers are elongated to some extent and each of the fibers are distinctly identified due to the application of tensile load as shown in the Figure 5. Due to the elongation effect, fibers have not affected much which leads to ductility failure. The bond between the reinforcement and the matrix medium is clearly seen.

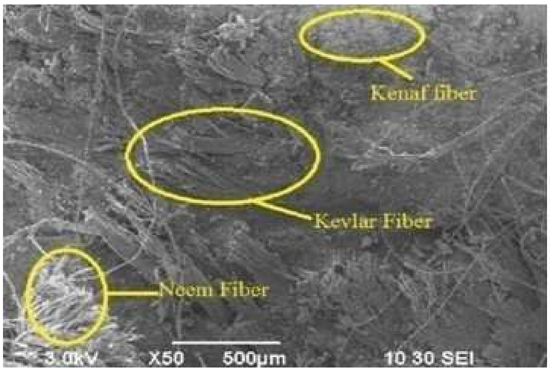

Figure 5: SEM Tensile Tested Specimen

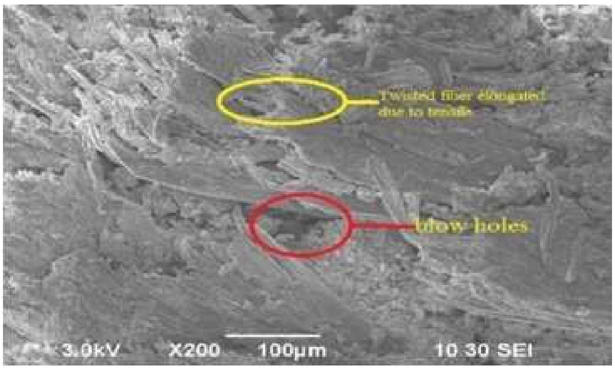

Figure 6: SEM Image of Flexural Specimen

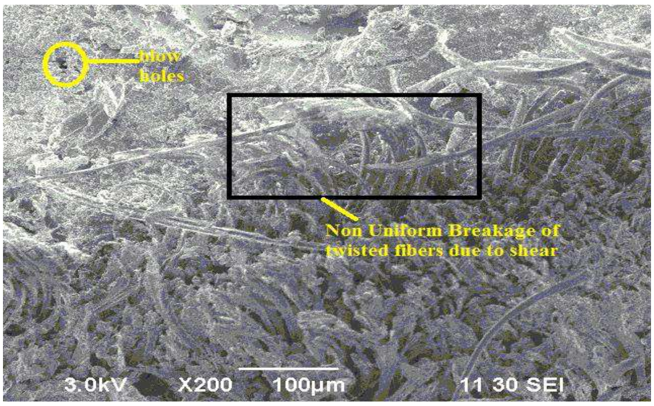

Figure 7: Shear Fracture

The Figure 7 shows the damage occurred due to double shear test on the specimen. Due to the shear effect the fiber breakage occurs which are not uniform throughout the surface because of the presence of twisted fiber which resist each other in opposite direction thereby it attains stable in particular stage.

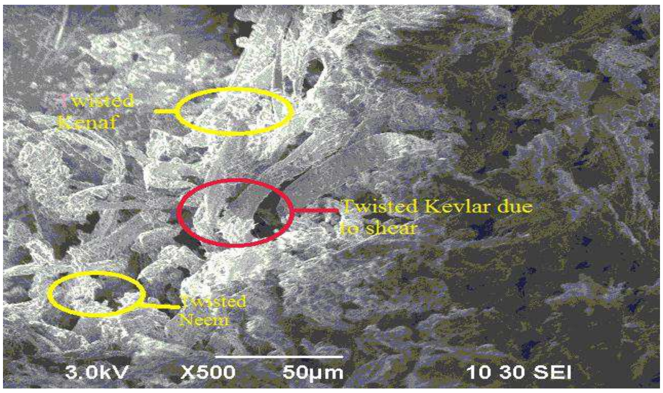

Figure 8: Overlapping of Fibers Due to Shear

The Figure 8 shows the fiber effect of double shear test on the specimen. Due to shear bend, twisted fibers overlapped each other forming concavity in nature progressing continuously which leads to breakage in some areas. It has also been observed that there is no sign of fiber separation in the remaining areas as the shear force was not distributed evenly throughout the laminate. In some places, blow holes are formed due to shear effect which is negligible leads to withstand high load carrying capacity in all directions.

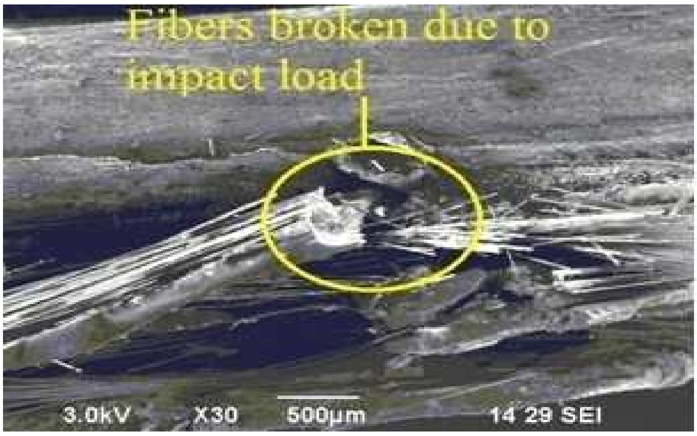

Figure 9: Impact Fracture

The Figure 9 shows the fibers in abnormal condition due to heavy blow. It has been seen that there is no uniformity in the breakage of fibers and also in some areas cracks are produced due to sudden blow. It has also been observed that the formation of debris exist on the surface. Even though the breakage of fibers exist, the abnormalities caused due to impact load is low in the remaining areas because of the presence of twisted fibers which resist impact load thereby it can withstand high impact resistance.

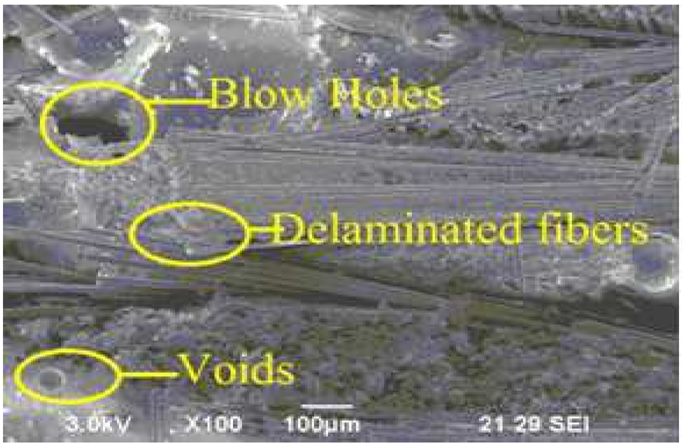

Figure 10: SEM Image of Delaminated Specimen

CONCLUSIONS

In tensile test, category sample resembles high tensile properties also Carbon fiber is imposed on the outer layer of the laminate. The other two categories because of twisted hybrid composites and Category Sample o recorded high value having a tensile strength of 28.84MPa with maximum break load of 4.2kN when compared to other samples of each category. Flexural load of 1.65kN is recorded high with maximum strength of 40.59MPa when compared to other categories due to the effect of twisted fibers which resist force during the flexural load. In double shear test, the maximum value is obtained in sample S1 of Category C3 of 4.04kN. it shows that the twisted fibers has high shear properties when compared to other two categories. In impact test, shows higher impact value of 10J as energy absorbed during the loading condition because of the effect of twisting the fibers with which resist the force to minimum level, thereby it reduces the damage of the sample. SEM images of various tests have been predicted. The results of various tests clearly shows that the image showing fiber fracture in some areas, presence of voids and blow holes, pullout of fibers, agglomeration of fibers

and the matrix during the testing and loading conditions. It also helps to predict the propagation of the crack in the composite sample.

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